Timed Urinary Oxalate Levels in Calcium Oxalate Stone Formers Undergoing a Trial of Spinach Consumption and Forced Hydration

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Background and Objective:

Kidney stones are a recurrent disease that afflicts ~12% of the world's population, and calcium oxalate (CaOx) is the most common mineral stone component. In vivo studies have shown that urinary oxalate, more than any other metabolite measured in a 24-hour urine collection, has the greatest influence on nucleation and formation of CaOx crystals (Robertson, 1993). Emerging data suggest that the incidence of hyperoxaluria, defined as urinary oxalate >40 mg (0.45 mmol)/day in adults, has doubled to more than 40% over the last twenty years (Spradling, 2016).

To decrease urinary oxalate, most urologists encourage CaOx stone formers to avoid foods high in oxalate (leafy green vegetables, chocolate, nuts, etc). This recommendation can overwhelm individuals already on other dietary restrictions and has been shown in randomized trials to have very little effect on 24-hour urinary oxalate excretion (Noori, 2014). Furthermore, a 24-hour urine collection can miss transient surges in urinary oxalate excretion that may promote stone growth. Considering the influence that urinary oxalate has on CaOx stone formation, we hypothesize that transient, dietary urinary oxalate peaks may correspond to increases in CaOx supersaturation and crystalluria. If so, these spikes may represent a distinct stone-formation risk and, perhaps, a viable target for individualized lifestyle monitoring and modification.

The objectives of this study are to (1) characterize urine oxalate trend following dietary high oxalate load (HOL) in recurrent CaOx stone formers and (2) evaluate the impact of vigorous hydration on timed urine oxalate concentrations after HOL.

Methods:

Using an existing and approved institutional IRB, we will enroll 40 CaOx stone formers who will provide 48-hours of voided urine, collecting and storing each urine sample in provided containers in a home setting prior to processing. Subjects will follow HOL (spinach) dietary protocol as described in Figure. Urinary oxalate levels will be measured for each individual void by enzymatic assay, and hourly oxalate excretion rate will be determined. Overall, UCr rate will also be determined. Overall, characterizing physiological variations in oxalate absorption and excretion in this population will allow us to create patient-specific recommendations for lifestyle changes and to develop a spot urine oxalate trial for high risk CaOx stone formers in the future.

Results:

Currently, 14 total participants are enrolled in the study. 4 participants have fully completed the collection with initial sample processing, however only one participant sample has been characterized for Oxalate metric characterization. Results are standardized to excretion rates and oxalate concentration for non-stone formers from our former study (Lemack et. al 2025). Preliminary results show no major difference in peak oxalate excretion rate, and a similar pattern of oxalate excretion rate peak post-HOL. Participant 1 showed no dampening of peak oxalate excretion for Day 2 collections despite forced hydration, suggesting an interesting trend as compared to non-stone formers.

Conclusion:

While this study is still in process with enrollment and initial sample collection, preliminary results suggest interesting trends regarding oxalate excretion patterns for chronic stone formers when compared to standardized non-stone forming participants. Further exploring peak oxalate rates on Day 2 with forced hydration can provide insight into a potential lack of oxalate dampening with hydration for those who increasingly produced CaOx stones. Together, these findings can help guide recommendations and lifestyle suggestions for stone formers, and better understand in-vivo variations in excretion patterns.

Figures:

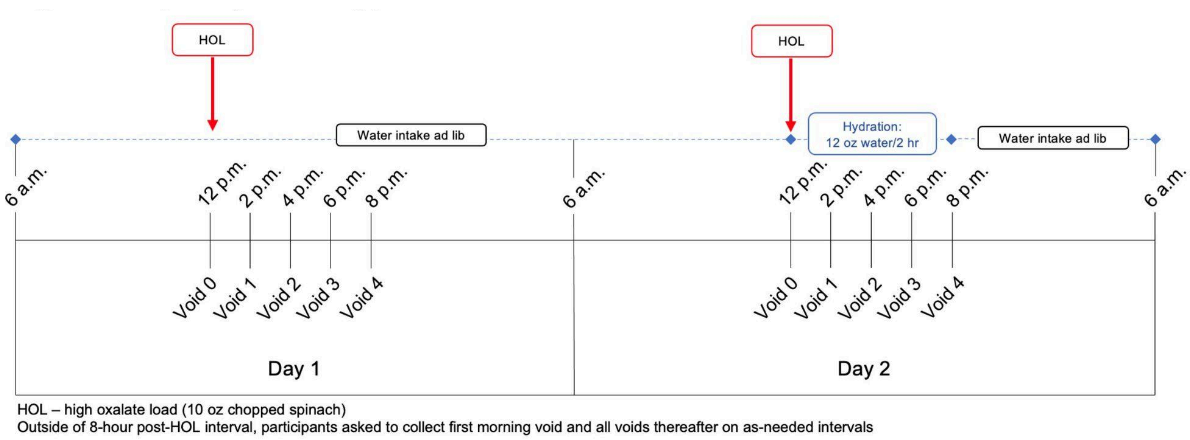

Figure 1: Study Diet and Void Log Protocol

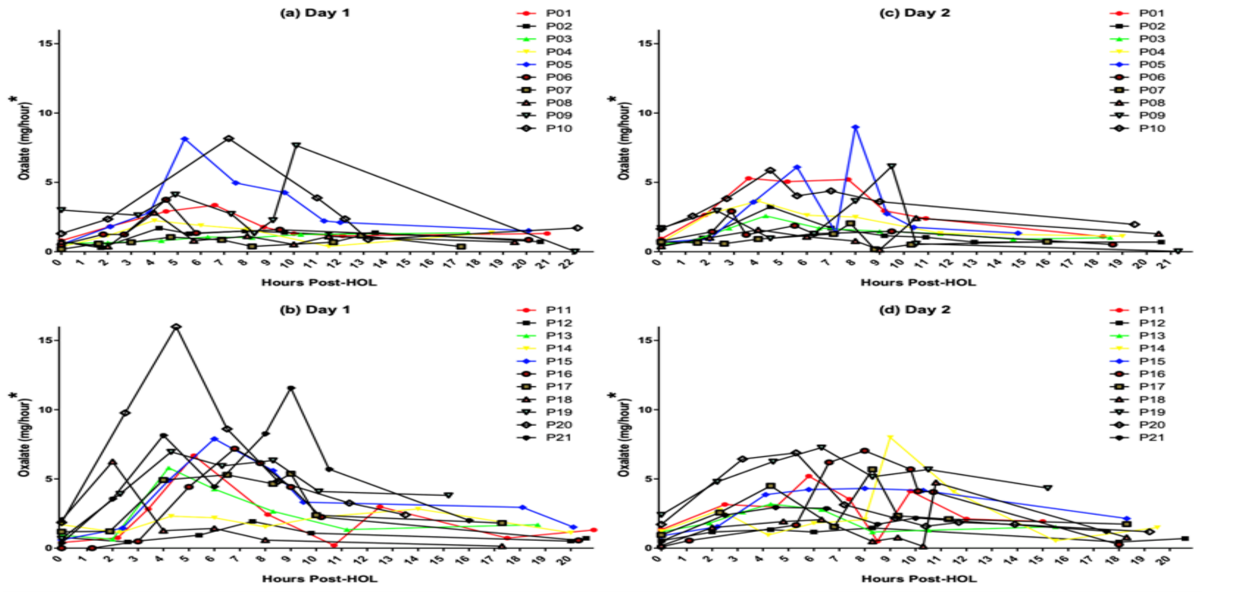

Figure 2: Results from Study on Non-Stone Forming Participants (Data Standard)

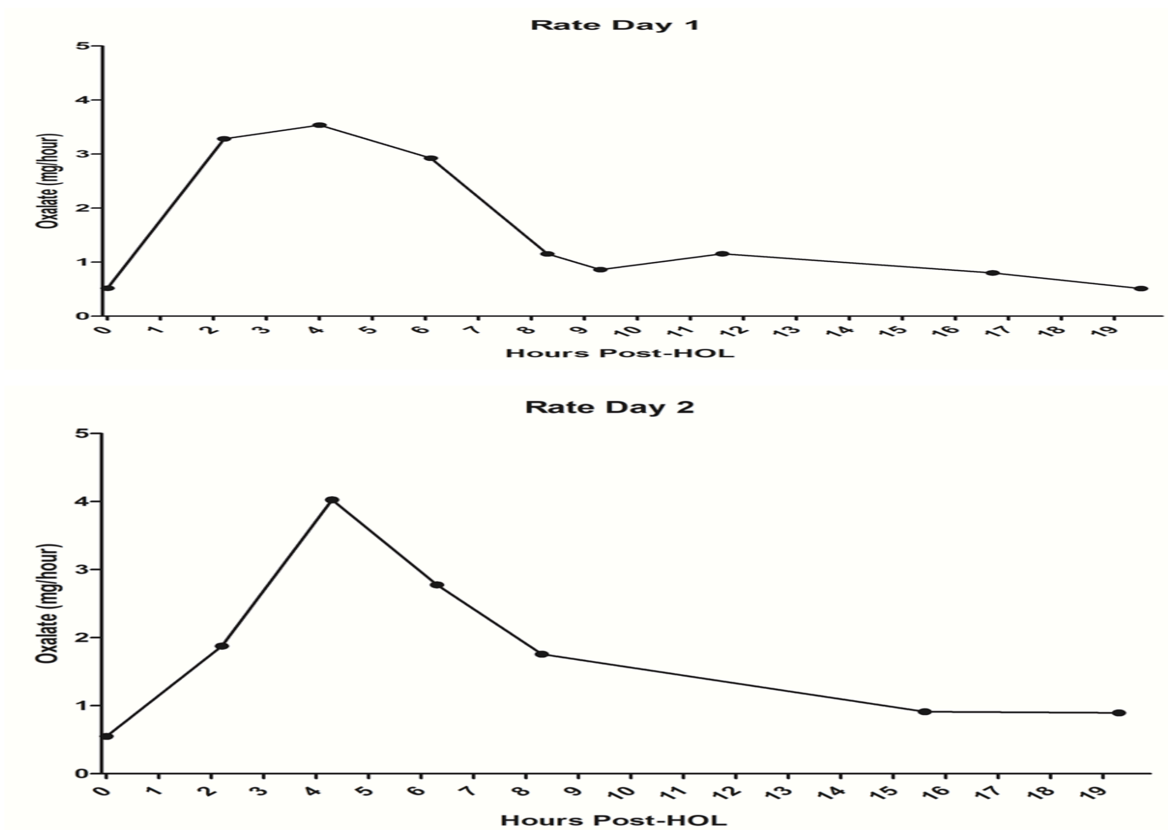

Figure 3: P1 Oxalate Excretion Rate post HOL, Day 1 and Day 2

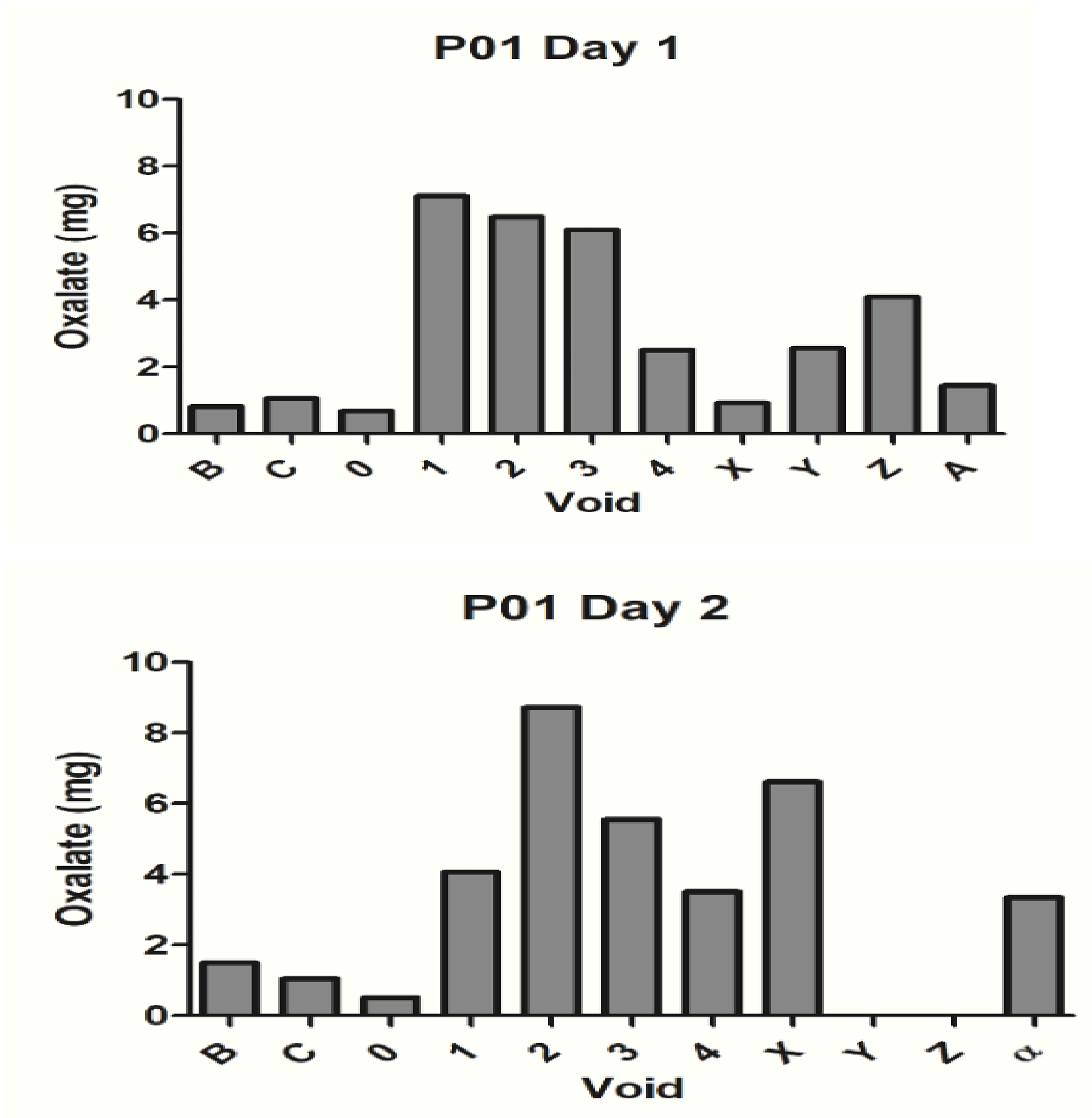

Figure 4: Oxalate Excretion by Void

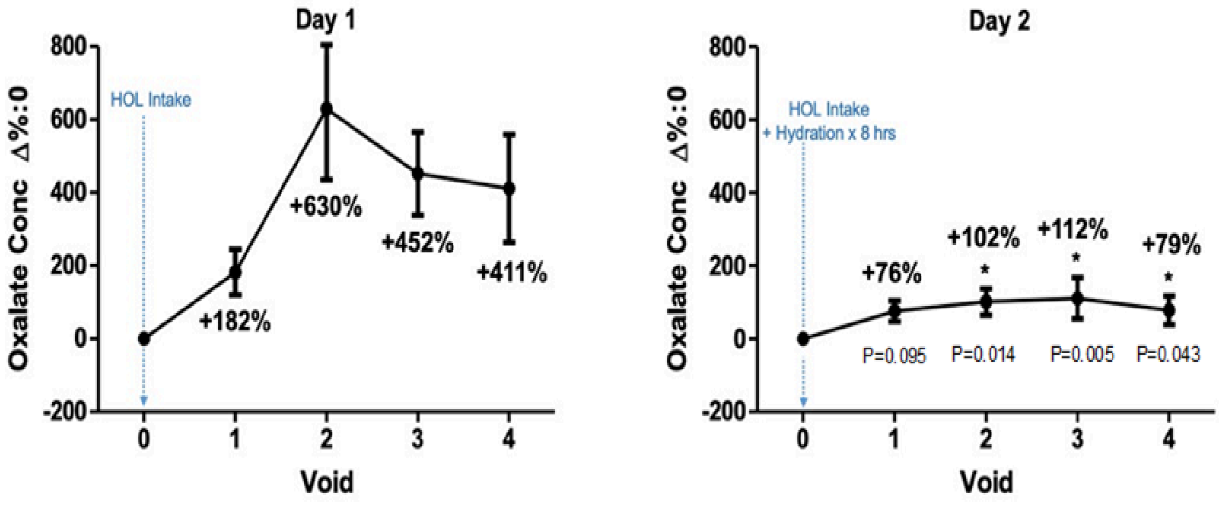

Figure 5: Change in Ox Concentration by Void, Post HOL